

REMARKS

This Preliminary Amendment cancels, without prejudice, claims 1 to 11 in the underlying PCT Application No. PCT/DE03/01672, and adds new claims 12 to 24. The new claims, inter alia, conform the claims to United States Patent and Trademark Office rules and do not add new matter to the application.

In accordance with 37 C.F.R. § 1.125(b), the Substitute Specification (including the Abstract, but without the claims) contains no new matter. The amendments reflected in the Substitute Specification (including Abstract) are to conform the Specification and Abstract to United States Patent and Trademark Office rules or to correct informalities. As required by 37 C.F.R. §§ 1.121(b)(3)(ii) and § 1.125(c), a Marked-Up Version of the Substitute Specification comparing the Specification of record and the Substitute Specification also accompanies this Preliminary Amendment. Approval and entry of the Substitute Specification (including Abstract) are respectfully requested.

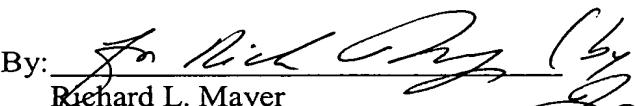
The underlying PCT Application No. PCT/DE03/01672 includes an International Search Report, dated November 4, 2003, a copy of which is included. The Search Report includes a list of documents that were considered by the Examiner in the underlying PCT application.

It is asserted that the subject matter of the present application is new, non-obvious, and useful. Prompt consideration and allowance of the application are respectfully requested.

Respectfully Submitted,

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DEVICE FOR DETERMINING AT LEAST ONE PARAMETER OF A MEDIUM
FLOWING IN A LINEBackground Information FIELD OF THE INVENTION

The present invention relates to a device for determining at least one parameter of a medium flowing in a line, ~~having the features according to the definition of the species in the independent Claim 1.~~

BACKGROUND INFORMATION

10 A device is made known in DE 101 35 142 A1 for determining the mass of a medium flowing in a line is described in published German patent document DE 101 35 142, the device including a part capable of being introduced into the line in which a measuring channel with a measuring element is located. Devices 15 of this nature are used, for example, as air-mass meters in the air-intake manifold of an internal combustion engine. Splash water, dust, and oil vapor can enter the air-intake manifold and be transported by the medium to the part of the device that is inserted in the line. To best prevent these 20 contaminants from entering the measuring channel, the known device includes an inlet region that discharges into a separation zone, and a measuring channel that branches off from the inlet region, so that the media stream that entered the inlet region divides, and a partial stream reaches the 25 inlet of the measuring channel. As a result, contaminants are best prevented from reaching the inlet of the measuring channel. The measuring channel includes a bent section downstream from its inlet, in which the partial stream of the medium that entered the measuring channel undergoes

redirection. The A disadvantage of this is that the stream may separate in the area of the bend and produce zones having a slower flow velocity, or even a backflow. Eddies and an irregularly pulsating flow occur in the region when there is 5 no contiguous flow. Since the bent section transitions into a further section equipped with the measuring element, the separation of the flow upstream from the sensor element has an unfavorable effect on the flow conditions at the sensor element, which can result in increased signal noise in the 10 sensor signal. The resultant change in the sensor signal ~~results may result~~ in a disadvantageous deviation of the measured results from the values that are actually present.

Advantages of the Invention SUMMARY

15 In contrast, a separation of the flow in the region of the bent section of the measuring channel is prevented by the device according to the present invention for determining at least one parameter of a medium flowing in a line having the characterizing features of Claim 1 has the advantage that a separation of the flow in the region of the bent section of the measuring channel is prevented. This is achieved via means that. This may be achieved via a projection that may project into the measuring channel, which are and that may be located downstream from the inlet and upstream from the measuring element, as viewed in the measuring channel flow direction, the means directing. The projection may direct the flow and counteracting counteract a separation of the flow of the partial stream of medium from the channel walls of the measuring channel. The flow may be directed around the bend by the means projection with little or no separation, which improves may improve the flow quality at the sensor element and reduces the signal noise.

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~~Advantageous exemplary embodiments and further developments of the present invention are made possible by the features indicated in the dependent claims.~~

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~~Advantageously, the means~~ In an example embodiment, the projection may include at least one single-component, continuous partition or ~~an~~ at least one interrupted, double-component partition that ~~is~~ may be located in the measuring channel transversely to the measuring channel flow direction. A plurality of partitions may also be situated behind each other or on top of each other in the measuring channel. The ~~at least one~~ partition ~~is~~ may be capable of being introduced into the measuring channel without a greater amount of manufacturing outlay. If a double-component partition is used, the partition may include two partial wall sections projecting that may project toward each other from diametrically opposed interior wall sections of the measuring channel and ~~being~~ that may be separated by a gap, ~~then~~ longitudinal. Longitudinal eddies advantageously may then occur at the ends of the partial wall sections that face each other, the axis of ~~this~~ the longitudinal eddy eddies extending in the measuring channel flow direction and the flow being stabilized.

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~~To~~ In an example embodiment, to prevent a film of water on the wall formed by water droplets that entered the measuring channel from detaching from the partition and resulting in water droplets coming in direct contact with the sensor element, it is particularly advantageous to position the back side – which faces away from the measuring channel flow – of the partition or the partial wall sections of the partition may be positioned at an angle relative to the measuring

channel flow direction that is less than ninety degrees and greater than zero degrees. The inclination of the back wall ~~results may result~~ in a cross-flow over the flow guide surfaces of the partition that extend parallel to the measuring channel flow, the cross-flow transporting water over the guide surfaces transversely to the measuring channel flow direction to the interior walls of the measuring channel, where the water ~~is~~ ~~may~~ be able to collect without reaching the sensor element.

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Drawings BRIEF DESCRIPTION OF THE DRAWINGS

~~Exemplary embodiments of the present invention are presented in the drawings and are described in the subsequent description.~~

Figure 1 shows a cross section through a ~~first exemplary embodiment of the part of the part of a device, according to the invention,~~ that is provided with the a measuring channel, in a position in which it is inserted in a ~~the~~ line, [[.]] according to an example embodiment of the present invention.

Figure 2 shows an enlarged detailed view that shows a cross section perpendicular to the plane of the drawing in Figure 1 through the measuring channel in the area of the a partition ~~for a further exemplary, according to an example embodiment of the present invention.~~

Description of the Embodiments DETAILED DESCRIPTION

30 Figure 1 shows a section of a line 3 through which a medium ~~flows may flow~~ in a main flow direction 18. The line may be an intake manifold of an internal combustion engine, for example.

The medium ~~is~~ may be, e.g., the air that is flowing in the intake manifold toward the internal combustion engine, ~~for example~~. A device 1 for determining a parameter of the medium flowing in line 3 ~~is~~ may be positioned in line 3 in such a 5 manner that a part 6 of this device ~~projects~~ may project into line 3 and ~~is~~ may be exposed to the medium flowing there at a predetermined orientation. Device 1 for determining at least one parameter of the medium ~~includes~~ may include, in addition to part 6 introduced in the line, a carrier part (not shown) 10 having an electrical connection, with evaluation electronics, for example, being housed in the carrier part. Device 1, with part 6, for example, may be inserted through an insertion opening 16 of a wall 15 of line 3, the wall 15 delineating a flow cross section of line 3. The evaluation electronics may 15 be located within and/or outside of the flow cross section of line 3.

A measuring element 9 on a measuring element carrier 10 ~~is~~ may be used in device 1, for example, the measuring element being 20 electrically connected to the evaluation electronics. Using measuring element 9, the volumetric flow rate or the mass flow rate of the flowing medium, ~~for example~~, may be ~~is~~-determined as the parameter, ~~for example~~. Further parameters that may be measured are, for example, pressure, temperature, 25 concentration of a medium constituent, or flow velocity, which ~~are~~ may be capable of being determined using suitable sensor elements.

Device 1 ~~has~~ may have, e.g., a longitudinal axis 12 in the 30 axial direction, which extends, e.g., in the direction of installation of device 1 in line 3, and which may also be the center axis, ~~for example~~. The direction of the medium flowing in the longitudinal direction of line 3, referred to herein

below as main flow direction 18, is labeled in Figure 1 with corresponding arrows 18, and extends there from right to left. When part 6 is installed in line 3, it ~~is~~ may be ensured that part 6 has a predetermined orientation relative to main flow 5 direction 18 of the medium.

Part 6 has a housing having a, e.g., rectangular structure having a front wall 13 that, in the installed position, ~~faces~~ may face main flow direction 18 of the medium, a back wall 14 10 facing away therefrom, a first side wall and a second side wall and a third wall 19 that ~~extends~~ may extend parallel to the main flow direction, for example. Part 6 may further ~~includes~~ include a channel structure located therein having an inlet region 27 and a measuring channel 40 that ~~branches~~ may branch off from inlet region 27. The positioning of device 1 15 relative to line 3 ~~ensures~~ may ensure that the medium flowing in main flow direction 18 impacts part 6 in a predetermined direction, and a partial stream of the medium in this direction ~~travels~~ may travel through an opening 21 in front 20 side 13 and ~~reaches~~ may reach inlet region 27. Opening 21 may be oriented perpendicularly to main flow direction 18, for example, but another orientation of opening 21 relative to main flow direction 18 is also feasible. From inlet region 27 forward, a partial stream of the medium that entered the inlet 25 region ~~passes~~ may pass through an inlet 41 into measuring channel 40 that ~~is~~ may be equipped with measuring element 9 and that ~~branches~~ may branch off from the inlet region. A portion of the medium in the inlet region ~~continues~~ may continue to flow into a separation zone located downstream 30 from the inlet of the measuring channel, this zone being connected to line 3 via at least one separation opening 33 located in the first side wall and/or the second side wall and/or wall 19.

Opening 21 in front side 13 of part 6 includes may include, in axial direction 12, a top edge 36 that is may be closest to measuring element 9 in axial direction 12. An upper, imagined 5 plane 39 extends through top edge 36 and perpendicular to the plane of the drawing in Figure 1 and parallel to main flow direction 18. Separation opening 33 is may be located, in axial direction 12, below this upper plane 39. Inlet region 27 is may be provided, in the region of opening 21, with inclined 10 or bent surfaces that are may be configured such that the medium flowing into the inlet region is may be directed away from upper plane 39. Liquid or solid-body particles that are contained in the partial stream of the medium that entered, and that are larger than and have a higher density than the 15 gaseous flowing medium may move in axial direction 12 away from upper plane 39. Since separation opening 33 is located below upper plane 39, the liquid and solid-body particles may collect in a separation zone [[28]] and are may be suctioned out into line 3 by the air that flows past separation opening 20 33.

Starting at inlet region 27, a partial stream of the medium passes may pass through inlet 41 of measuring channel 40 and reaches may reach a first, bent section 42 of the measuring 25 channel. The partial stream of the medium that entered the measuring channel flows may flow through the measuring channel in measuring channel flow direction a from inlet 41 to outlet 48 of the measuring channel. For clarification, it should be mentioned that, in the context of the present application, 30 "measuring channel flow direction" is understood refers to be the direction of flow from the inlet to the outlet of the measuring channel, and not the velocity vectors of the individual flowing particles. The measuring channel flow

direction therefore extends along the measuring channel and its bends to the outlet. The partial stream that traveled through inlet 41 into measuring channel 40 is may be redirected in first, bent section 42 and, at the end of section 42, reaches may reach a further section 44, that extends may extend nearly in a straight line and in which measuring element 9 is may be located. At the inner radius of bent section 42, the flow may separate from interior wall 43 of the measuring channel if countermeasures are not provided.

5 In Figure 1, the separated flow is depicted by dashed line 60. Eddies and irregular pulsations may develop in the separated flow, which may have a disadvantageous effect on the flow in subsequent, further section 44 with measuring element 9.

10 To prevent the flow from separating in bent section 42, measuring channel 40 may therefore ~~includes means~~ 50 include a projection projecting into the measuring channel, ~~the means~~ directing. The projection may direct the flow and counteracting counteract a separation of the flow from interior wall 43 of the measuring channel and, ~~in the most favorable case, e.g.,~~ preventing it entirely. The partial stream of the medium may then flows flow, without separating, into further section 44 of the measuring channel. In an ~~advantageous exemplary~~ example embodiment, the ~~means~~ projection may include at least one single-component, continuous partition 50, which is may be located transverse to measuring channel flow direction a in the transitional region from bent section 42 to further section 44. Partition 50 is may be attached with two end sections facing away from each other and that are not shown in Figure 1 to diametrically opposed wall sections of the interior wall of the measuring channel in such a manner that a line that connects the two end sections of the partition may extend nearly perpendicular to

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measuring channel flow direction a and, therefore, in Figure 1, also perpendicular to the plane of the drawing. The partition ~~includes~~ may include a narrow front side 53 that ~~faces~~ may face measuring channel flow direction a, a back side 54 ~~facing that may face~~ away therefrom, and two flow guide surfaces 51 and 52 ~~extending that may extend~~ essentially parallel to the measuring channel flow direction. The partition may be rounded off at front side 53 and have a guide vane geometry or guide blade geometry.

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As shown in Figure 2, in another exemplary example embodiment, partition 50 may also be configured as two components and include two partial wall sections 50a and 50b that ~~are~~ may be attached with end sections 55a and 55b to diametrically opposed internal wall sections 45a, 45b of measuring channel 40 and ~~may~~ project toward each other and ~~are~~ preferably. In one example embodiment, the two partial wall sections ~~may be~~ separated by a gap 59. ~~Front~~ In one example embodiment, front sides 53a and 53b of the partial wall sections ~~are~~ may be oriented ~~preferably~~ perpendicular to measuring channel flow direction a. It is particularly preferable when In one example embodiment, back sides 54a and 54b of partial wall sections 50a, 50b ~~are~~ preferably ~~may be~~ flat and, as viewed in the cross section of Figure 2, ~~may~~ form an angle α with measuring channel flow direction a that is less than ninety degrees and greater than zero degrees, and is preferably e.g., less than 70 degrees and greater than thirty degrees. If partition 50 has a single-component configuration as depicted in the exemplary example embodiment in Figure 1, the single back wall may be oriented relative to the measuring channel flow direction at an angle that is less than ninety degrees and greater than zero degrees. The transverse position of back sides 54a, 54b in Figure 2 ~~results~~ may result in a transverse

flow in the direction of arrow b over flow guide surfaces 51 and 52 extending parallel to measuring channel flow direction a, the. The transverse flow transporting may transport water contained in the flow over the flow guide surfaces transverse 5 to measuring channel flow direction a to interior walls 45a and 45b of the measuring channel, where water 61 is may be able to collect without reaching sensor element 9.

Downstream from partition 50 in Figure 1 or partial wall 10 sections 50a and 50b in Figure 2, the medium flows may flow into further section 44 toward measuring element 9. The cross section of further section 44 tapers may taper in measuring channel flow direction a, which is may be achieved via two acceleration ramps that face each other, whereby, in the 15 depiction in Figure 1, the observer is looking at a first ramp from a perpendicular perspective. As a result of the tapering of the cross section and/or the acceleration ramps in the form of a narrowing of the lateral surfaces of measuring channel 40 on all sides or partially, the medium is may be transported rapidly through the measuring channel in measuring channel 20 flow direction a and, as a result, may suction air coming after it out of inlet region 27. From further section 44 forward, the medium is may be redirected downstream from measuring element 9 into a channel section 47 that extends may 25 extend away from insertion opening 16 approximately in axial direction 12. From this channel section forward, it is may be redirected into a final channel section 48 that extends may extend, e.g., against main flow direction 18, and passes may pass through outlet 49 of measuring channel 40, which is may 30 be located, e.g., perpendicular to main flow direction 18 or at an angle to main flow direction 18, that is different from zero degrees, back into line 3.

Abstract

ABSTRACT

A device is described for determining at least one parameter of a medium flowing in a line [[3]] in a main flow direction 18, in particular the mass of intake air for an internal combustion engine. The device includes a part 6 that is capable of being introduced into the line 3 with a predetermined orientation relative to the main flow direction 18 in such a manner that includes a part adapted for introduction into the line. The part may include a measuring element for determining the at least one parameter; a measuring channel that may include an inlet, an outlet, a bent first section between the inlet and the measuring element, and a second section into which the first section may transition, the measuring element being located in the second section; and a projection, where a partial stream of the medium flowing through the line flows through at least one measuring channel 40, in which a measuring element 9 is located, that is provided in the part. The measuring channel includes, between an inlet 41 and the measuring element 9, a bent section 42 for redirecting the partial stream of the medium that entered may flow in a measuring channel flow direction from the inlet to the outlet, the first section may redirect the partial stream after entering the measuring channel through the inlet 41, the bent section transitioning into a further section 44 of the measuring channel having the measuring element, the measuring element being located in this further section. To improve the flow conditions, means 50 that, and the projection may project into the measuring channel are located at a location downstream from the inlet 41 and upstream from the measuring element 9, as viewed in relative to the measuring channel flow direction a, the means directing the flow and counteracting to direct the flow of the partial stream, and counteract a

separation of the flow of the partial stream ~~of the medium~~
from the channel walls of the measuring channel.